



LINEUP WITH MATH™

Math-Based Decisions in Air Traffic Control for Grades 5 - 9

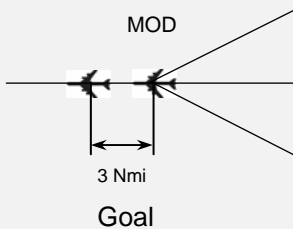
Problem Set B

Resolving 2-Plane Traffic Conflicts by Changing Route

Teacher Guide with Answers and Solutions

Two planes on merging routes are:
 -- traveling at the same speed.
 An alternate route is available.

Overview of Problem Set B



Estimated class time:
 1.5 – 2 hours

Objectives

In this Problem Set, students will determine whether two planes traveling on different merging routes will line up with proper spacing at MOD (the last intersection before the planes leave the airspace sector). If the spacing is not adequate, students will analyze an alternate route for one plane.

The planes are traveling at the same altitude and the same constant (fixed) speeds.

Of all the *LineUp With Math™* Problem Sets, this is the simplest. There are only two planes and a simple route change will solve each problem. A speed change is not required to resolve a spacing conflict.

Each problem can be explored with the interactive Air Traffic Control (ATC) Simulator. Three of the problems can be more closely examined with Student Workbook B (print-based). The Workbook provides a structured learning environment for exploring the problems with paper-and-pencil worksheets that introduce students to pertinent air traffic control concepts as well as problem analysis and solution methods.

Prerequisites

Students will:

- Analyze a sector diagram to identify a spacing conflict between two planes, each traveling at the same speed.
- Resolve the conflict by changing the route for one plane.

Materials

Before attempting the current Problem Set, it is *strongly* recommended that students complete Problem Set A that introduces essential air traffic control vocabulary, units, and representations.

- ATC Simulator (web-based)
- Student Workbook B (print-based)

Teachers access the materials by visiting the *LineUp With Math™* website:

<http://www.smartskies.nasa.gov/lineup>



A separate **student** website gives students easy access to the Simulator and supporting materials (not to the answers and solutions on the teacher website):

<http://www.atcsim.nasa.gov>

ATC Simulator

A complete description of the ATC Simulator is contained in the Educator Guide for LineUp With Math™.

For a Simulator User Guide and an animated tutorial, visit the LineUp With Math™ website.

Student Workbook

It is recommended that you have a copy of Student Workbook B open while you read these notes.

The worksheet title is the same as the associated Simulator problem.

*In the sector diagram, each route flows only **towards** MOD. E.g., a plane may fly from MINAH to OAL, but cannot fly from OAL to MINAH.*

Interactive Air Traffic Control Simulator

Students first explore Problem Set B with the interactive ATC Simulator. Each problem features a 2-plane conflict that can be resolved by a route change.

The Simulator problems for Problem Set B are:

2-1*; 2-2*; 2-3*; 2-9; 2-10

Problems with an asterisk (*) are supported by worksheets in Student Workbook B.

For a complete set of solutions to all Problem Set B Simulator problems, see Appendix I of this document.

For a discussion of the key points associated with the first three Simulator problems, see the worksheet notes in the following Student Workbook section of this document.

The Student Workbook consists of three worksheets, one for each of the three featured Simulator problems listed below.

<u>Simulator Problem</u>	<u>Worksheet Title</u>
2-1*	Problem 2-1
2-2*	Problem 2-2
2-3*	Problem 2-3

Each problem features a spacing conflict with different starting conditions. As students progress through the worksheets, they likely will require less guidance and structure, and the subsequent worksheets reflect this.

For a complete set of answers to each worksheet, see Appendix II of this document.

For each worksheet, the key points are briefly described as follows.

Worksheet: *Problem 2-1*

- Each plane starts at a different distance from MOD. The difference between the planes' starting distance from MOD represents a "headstart" for the closer plane.
- Since the planes are traveling at the same speed, the closer plane maintains its "headstart".
- With the new route, the planes' spacing at MOD will be greater than the Ideal Spacing. A route change may provide additional spacing, but does not guarantee Ideal Spacing. In a later Workbook, students will have the opportunity to change plane speeds as well as the route, and thus achieve Ideal Spacing exactly.



Worksheet: *Problem 2-2*

- This problem is similar to Problem 2-1, but students work more independently, with less guidance and structure.

Worksheet: *Problem 2-3*

- This problem is similar to Problems 2-1 and 2-2. However, in this problem, students are expected to analyze and identify the spacing conflict on their own. Minimal structure is provided to guide students to a solution.

Answer Sheets

For a set of solutions to all Simulator problems, visit the LineUp With Math™ website.

Solutions for each of the Problem Set B Simulator problems can be found in Appendix I of this document.

Answer sheets for each worksheet in Student Workbook B can be found in Appendix II of this document.